FACULTY OF **BIOSCIENCE ENGINEERING**

ECONOMIC AND ECOLOGIC ASSESSMENT OF CONCENTRATED MANURE PRODUCTION IN FLANDERS

Gwen Willeghems[1], Lies De Clercq[2], Evi Michels[2], Erik Meers[2], Jeroen Buysse[1]

[1]Department of Agricultural Economics, Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, 9000 Ghent, Belgium

[2]Laboratory of Analytical Chemistry and Applied Ecochemistry (ECOCHEM), Faculty of Bioscience Engineering, Ghent University, Coupure Links 653, 9000 Ghent, Belgium

E-mail: Gwen.Willeghems@Ugent.be; Jeroen.Buysse@Ugent.be

Introduction

- European regions with **intensive livestock production**, such as Belgium (Flanders), are facing a big challenge to cope with **manure surpluses** primarily from pigs. Manure management causes a big **environmental problem**, since it is associated with nutrient leaching to ground and surface water and large amounts of **greenhouse gas (GHG) emissions**, mainly methane and nitrous oxide.

- The main bottleneck of manure management in Flanders is the **strongly concentrated** production of livestock and manure in the province West Flanders and the northern part of Antwerp (red and orange areas on *Figure 1*). Furthermore, transport occurs mainly to Zeelandic Flanders and Northern France, while transport to Wallonia is not allowed ("manure border" between Flanders and Wallonia).

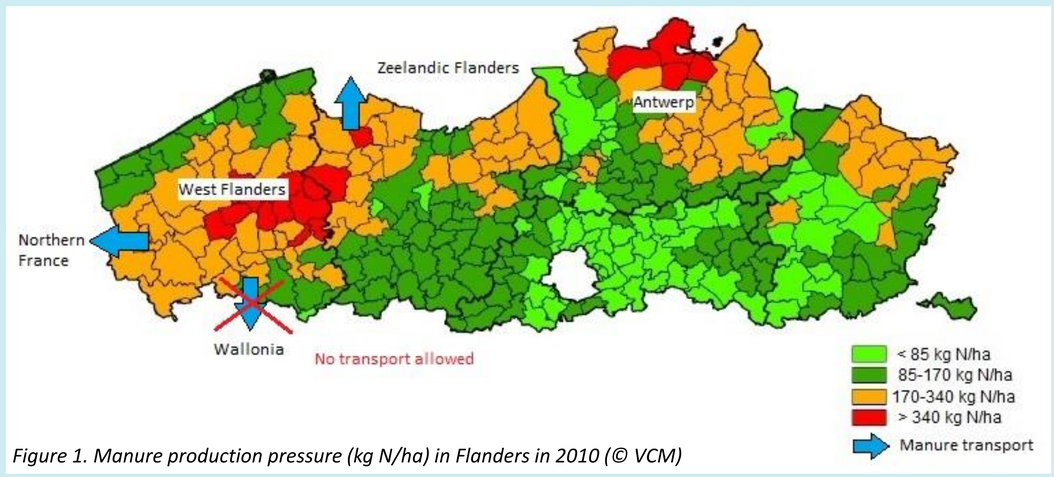

Figure 1. Manure production pressure (kg N/ha) in Flanders in 2010 (© VCM)

- This research explores if **more evenly spreading** livestock (pig) production would **decrease the carbon footprint** (expressed in CO_2-equivalents). Furthermore, it is investigated if **manure transport** from Flanders (nutrient rich) to Wallonia (nutrient poor), which is not allowed yet, could possibly result in important cost and greenhouse gas emission savings.

Methodology

- An economic (cost minimization) and environmental (carbon footprint minimization) optimization was carried out using a manure allocation model, with the option to open the "manure border" (Flanders-Wallonia). Four scenarios were investigated:
  - **Scenario 1:** Minimized **cost** for a **closed** manure border
  - **Scenario 2:** Minimized **carbon footprint** for a **closed** manure border
  - **Scenario 3:** Minimized **cost** for an **open** manure border
  - **Scenario 4:** Minimized **carbon footprint** for an **open** manure border

  Each scenario took into account 3 manure management options:
  a) raw manure **transport** (including storage and application)
  b) manure **processing** (including storage, biological treatment of the liquid fraction and export of the composted thick fraction)
  c) manure **separation** (including storage, application of the liquid fraction and export of the composted thick fraction)

- To translate the **spreading of livestock production** to the model, we assumed that the effect of livestock production spreading equals the effect of relaxing fertilisation standards, thus **allowing more nutrients from manure** to be put on the field. In this case **1 kg N per ha** per municipality is considered. The model calculated the **marginal CO_2 impact** of this increase.

Conclusion

- The **economic** optimum is reached by maximizing the **transport** of raw manure, while the **ecologic** (carbon footprint) optimum is reached by **separating** all manure as this option has the lowest CO_2 emissions due to the **limited storage time** (3 months are assumed).

- **Spatial spreading** of livestock production in Belgium will **not** substantially **decrease CO_2 emissions**.

- **Greenhouse gas emissions** from manure management can mainly be **lowered** by keeping the **storage time** as **short** as possible.

Results and discussion

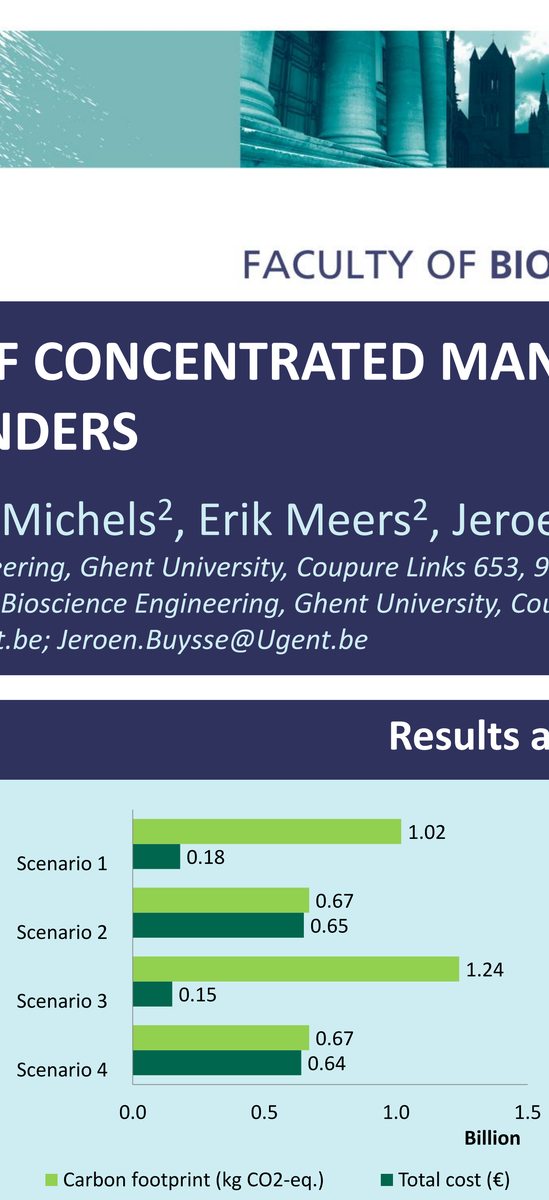

Figure 2. Outcomes of the 4 model scenarios (in billion euro or billion kg CO_2-equivalents)

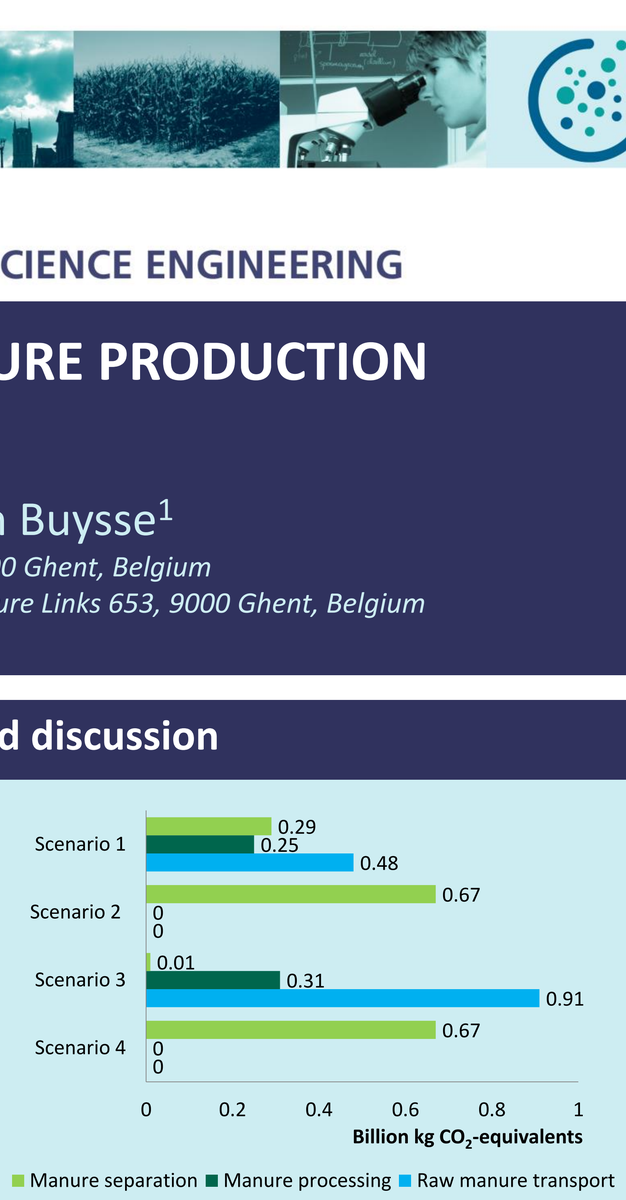

Figure 3. Overview of the carbon footprint (in billion kg CO_2 -equivalents), shown per manure management option

- When the carbon footprint is minimized (Scenario 2 and 4), there is no difference between a closed (Scenario 2) or open (Scenario 4) border.

- A **lower cost** coincides with a **higher carbon footprint** and vice versa.

- When costs are minimized, the carbon footprint in Scenario 3 (open border) is higher in comparison to Scenario 1 (closed border) as more raw manure is transported over the border from Flanders to Wallonia. **Transport** is the **cheapest** but **most polluting** option mainly due to the **long storage period** (6 months is assumed).

- In the scenarios with carbon footprint minimization (Scenario 2 and 4) the model opts to **mechanically separate** all manure, which leads to the **lowest amount of greenhouse gas emissions** because the **storage time** of raw manure is **limited** (3 months is assumed).

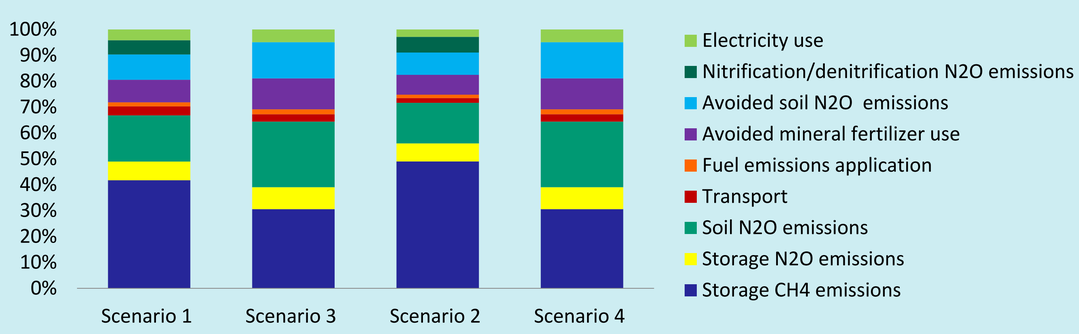

Figure 4. Graphical overview of the 4 model scenarios depicting the share of each type of emission source

- In the scenarios with cost minimization (Scenario 1 and 3) almost half of the total greenhouse gas emissions are due to **methane emissions** from **storage** (before transport).

- **Transport** as such doesn't account much to the total carbon footprint.

- The effect of **livestock spreading** is translated into the marginal CO_2 impact of 1 kg N/ha extra allowed to be applied on the field (*Figure 5*).

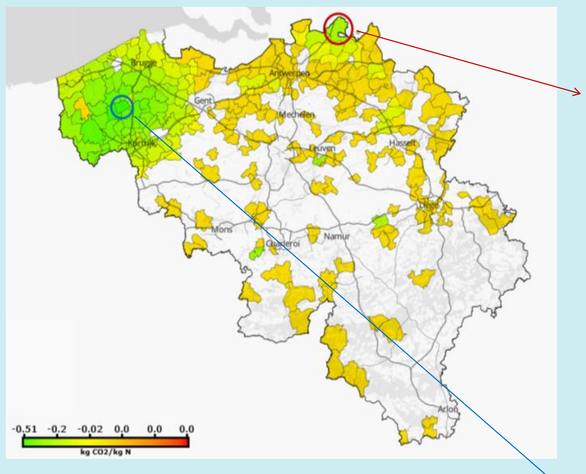

Figure 5. Marginal CO_2 impact of 1 kg N increase in fertilization standards per municipality when minimizing the carbon footprint (and thus all manure is mechanically separated)

- In **Hoogstraten** (Antwerp), a municipality with a high carbon footprint from manure management, the carbon footprint decreases by **0.25 kg CO_2** when **1 extra kg N** is allowed on the field (simulating less concentrated pig production).

- This decrease (0.25 kg CO_2/kg N) is caused by a **decrease in transport** of (separated) manure, since more N is allowed on the field, corresponding with **125 kg of manure** being transported over a distance of **20 km**.

- The maximum reduction that can be reached in this analysis is **0.51 kg CO_2** for the municipality **Hooglede** (West Flanders).

- Thus, a **spatial rearrangement** of pig production in Belgium will **not substantially decrease the carbon footprint** of this agricultural activity.

Investing in Opportunities
This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 289712.